National Aeronautics and Space Administration

The Critical PATH

2014 Winter Issue / A Flight Projects Directorate Publication

NASA's Search and Rescue Mission

In June 2010, 16-year-old Abby Sunderland attempted to break the record for being the youngest person ever to complete a solo sail around the world. But when she found herself stranded at sea after a storm damaged her boat, Abby's life was saved by a Personal Locator Beacon (PLB), which transmitted a distress signal to a Search and Rescue (SAR) satellite, 22,500 miles away in space. What many do not know is that the PLB that saved Abby Sutherland's life was developed by the NASA SAR Mission Office at Goddard Space Flight Center, a major participant in a system that has saved over 35,000 lives worldwide.

The NASA SAR Mission Office supports national and international SAR objectives as a voting member in the U.S. SAR Satellite Aided Tracking (SARSAT) and International COSPAS-SARSAT Program (ICSP). This support includes research and development or application of technology to search, rescue, survival, and recovery systems and equipment, such as location tracking systems, transmitters, receivers, and antennas capable of locating aircraft, ships, spacecraft, or individuals in potential or actual distress. NASA performs SAR research and development as a member of the National Search and Rescue Council (NSARC) and supports the U.S. SARSAT Program through an interagency Memorandum of Understanding with the U.S. Coast Guard, Air Force, and NOAA.

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Inside This Issue

Finding New Worlds: TESS is Confirmed to Enter Phase C

Exoplanets, planets around other stars than our own, have recently excited the imagination of the public. Several NASA missions and ground-based observatories have located these new worlds and began to study them. To date, roughly 2,000 exoplanets have been discovered. However, much of the sky remains unexplored.

Enter the Transiting Exoplanet Survey Satellite (TESS), a new mission lead by the Goddard Space Flight Center. In the first-ever spaceborne all-sky transit survey, TESS plans to discover thousands of

(TESS continued on page 4)

Message from the Director Of

George Morrow

Since the last issue of The Critical Path, the Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft successfully entered Mars orbit on September 21, 2014. What an exciting event! Since then, all instruments were reactivated and all deployments were successfully completed. The spacecraft orbit is being slowly adjusted to the final science orbit with full science operations targeted for November 15. Congratulations to Bruce Jakosky, MAVEN Principal Investigator, Dave Mitchell, MAVEN Project Manager, and the entire MAVEN team!

All four Magnetospheric Multi-scale spacecraft completed environmental testing and the first two left Goddard Space Flight Center (GSFC) on October 27, 2014, bound for the Astrotech integration facility near Kennedy Space Center. The second two spacecraft will be shipped during the first week of November. Launch is scheduled for March 12, 2015, on a United Launch Alliance Atlas V.

Similarly, the Deep Space Climate Observatory finished pre-ship activities and will also ship to Astrotech in mid-November. Launch is scheduled for January 23, 2015, on an Air Force acquired SpaceX Falcon 9 launch vehicle.

James Webb Space Telescope is also making great progress. The second cryo-vacuum test of the Integrated Science Instrument Module was successfully completed in September 2014. This 116-day test was the most complex thermal vacuum test ever performed at GSFC. Further, the JWST telescope pathfinder has two flight spare primary mirror segments and the flight spare secondary mirror installed and aligned in the Building 29 cleanroom. It is a sight to see.

With the news that our long-time Editor of The Critical Path, Howard Ottenstein, is finally saying goodbye to Goddard, I'd like to acknowledge his contributions to GSFC and to the Flight Projects Directorate (FPD) in particular. It's quite amazing to consider holding one position for 23 years, but this year marked the 23rd anniversary of The Critical Path, with Howard holding down the helm as Editor for the entire life of the newsletter. We haven't entirely given up on the idea of him still contributing from his new home on Long Island, but everyone in the FPD wishes him the best for this next stage in his life. I'd like to add my personal thanks for his dedication, irreverent humor, and commitment to building a cohesive Code 400 team.

As the holidays approach, please make every effort to schedule some time away from work to spend with family and friends.

Sincerely,

George W. Morrow
Director of Flight Projects
george.w.morrow@nasa.gov

Personality Tintypes

Keith Waylus

Keith is the Mission Manager for the Neutron star Interior Composition ExplorER (NICER) and the Astro-H Soft X-Ray Spectrometer (SXS). Astro-H is a collaborative effort with the Japanese Space Agency.

Keith Waylus

Born:

Summit, New Jersey

Education:

BS: Aerospace Engineering, University of Maryland

MS: Mechanical Engineering, University of Houston

Life Before Goddard

Keith started his career at Johnson Space Center in 1985 in the Mission Operations Directorate as a second lieutenant in the Air Force, where he worked designing Space Shuttle entry trajectories. He was part of an Air Force contingent that was sent down to JSC in preparation for the construction of an Air Force operated mission control center that was to be built in Colorado Springs, Colorado. After the Challenger explosion, the Air Force abandoned the idea of a separate Air Force operated control center and the Air Force contingent stayed at JSC. After completing his commitment, Keith left the Air Force and remained as a NASA engineer at JSC. He left JSC and came up to Goddard in 1993.

Life at Goddard

Keith has held various positions at Goddard including Mission Director for the Solar and Helio-

(Waylus continued on page 21)

Valerie Mackritis

Valerie has been working as a Mission Business Manager in the Explorers and Heliophysics Program Office (Code 460) for the past 4 years, supporting the Interface Region Imaging Spectrograph (IRIS) and the Neutron star Interior Composition ExploreR (NICER) missions.

Valerie Mackritis

Born:

Charleston, South Carolina

Residence:

Salisbury, Maryland

Education:

Master of Business Administration,
University of Phoenix;

B.A Marketing, Clark Atlanta University.

Life at Goddard

Valerie arrived at NASA Wallops Island in 2003 and worked as a Resource Analyst for the Suborbital and Special Projects Orbital Projects, Code 800. She supported the Code 803 Aircraft Office as a Resource Analyst performing duties for budget development, analysis and submissions of budget exhibits for annual budgets. Valerie later transitioned to GSFC as a Senior Resource Analyst in the Science and Exploration Directorate, Administration and Resource Management, Code 603. She provided financial support to the Ice, Clouds, and Land Elevation Satellite **(**ICESat**)** and Landsat Data Continuity and LandSat missions. Her duties included executing Line of Business Financial Reports and

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exoplanets in orbit around the brightest stars in the sky.

"During its first two years in orbit, the TESS spacecraft will concentrate its gaze on several hundred thousand specially chosen stars, looking for small dips in their light caused by orbiting planets passing between their host star and us," said TESS Principal Investigator Dr. George Ricker of the Massachusetts Institute of Technology (MIT). During the third year, ground-based astronomical observatories would continue monitoring exoplanets identified earlier by the TESS spacecraft.

As an exoplanet crosses in front of its host star, the exoplanet can be detected by a drop in the star's brightness; this is called a transit. Information gathered from the transit and further study can help determine characteristics of the new world. TESS will monitor more than 500,000 stars for planetary transits. TESS is expected to find more than 5,000 exoplanet candidates, including 50 Earth-sized planets. It will also find a wide array of exoplanet types, ranging from small, rocky planets to gas giants. Some of these planets could be the right size, and orbit at the correct distance from their star, to potentially support life.

The lead institution for TESS science is the MIT, which hosts the Principal Investigator, Dr. George Ricker. The MIT Lincoln Laboratory is responsible for the cameras, including the lens assemblies, detector assemblies, lens hoods, and camera mount. NASA's GSFC provides project management, systems engineering, and safety and mission assurance. Orbital Sciences Corporation (OSC) builds and operates the spacecraft. The mission is operated from the OSC Mission Operations Center.

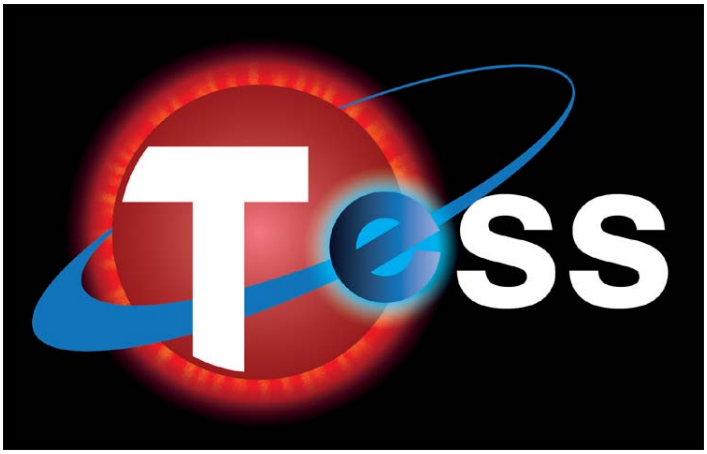
The TESS Science Center, which analyzes the science data and organizes the co-investigators, collaborators, and working groups (with members from many institutions) is a partnership among MIT's Physics Department and Kavli Institute for Astrophysics and Space Research, the Smithsonian Astrophysical Observatory, and NASA's Ames Research Center. The raw and processed data are archived at the Mikulski Archive for Space Telescopes, at the Space Telescope Science Institute.

"The most exciting part of the search for planets outside our solar system is the identification of 'earthlike' planets with rocky surfaces and liquid water as well as temperatures and atmospheric constituents that appear hospitable to life," said TESS Project Manager Jeff Volosin. "Although these planets are small and harder to detect from so far away, this is exactly the type of world that the TESS mission will focus on identifying."

TESS was selected in 2013 as an astrophysics mission in the Explorers Program. In November of 2014, the project was officially confirmed by NASA HQ that allows TESS to move forward into the development phase (Phase C).

"After spending the past year building the team and honing the design, it is incredibly exciting to be approved to move forward toward implementing NASA's newest exoplanet hunting mission," said Volosin.

TESS is designed to complement several other missions in the search for other planets. Once TESS finds nearby exoplanets to study and determines their size, ground-based observatories and other



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NASA missions, like the James Webb Space Telescope (JWST), would make follow-up observations on the most promising candidates to determine their density and other key properties. By figuring out a planet's characteristics, like its atmospheric conditions, scientists could determine whether the targeted planet has a habitable environment.

"TESS should discover thousands of new exoplanets within 200 light years of Earth," Ricker said. "Most of these will be orbiting bright stars, making them ideal targets for characterization observations with NASA's JWST."

"The Webb Telescope and other teams will focus on understanding the atmospheres and surfaces of these distant worlds, and someday, hopefully identify the first signs of life outside of our solar system," Volosin said.

TESS will use four cameras to study sections of the sky's north and south hemispheres, looking for exoplanets. The cameras would cover about 90 percent of the sky by the end of the mission. This makes TESS an ideal follow-up to the Kepler mission, which searches for exoplanets in a fixed area of the sky. Because the TESS mission surveys the entire sky, TESS is expected to find exoplanets much closer to Earth, making them easier for further study.

In addition, Ricker said TESS would provide precision full frame images for more than twenty million bright stars and galaxies.

"This unique new data will comprise a treasure trove for astronomers throughout the world for many decades to come," Ricker said.

Now that TESS is cleared to move into the next development stage, it can continue towards its goal of being a key part of NASA's search for life beyond Earth.

"I'm still hopeful that in my lifetime, we will discover the existence of life outside of our solar system and I'm excited to be part of a NASA mission that serves as a key stepping stone in that search," Volosin said.

Contributors from the TESS Team

TESS Team

(SARSAT continued from page 1)

The NASA SAR Mission Office at GSFC was formed in the 1970s and serves as the designated agency to perform SAR Research and Development (R&D) in an effort to meet SAR needs.

Some of the major roles of the SAR Mission Office include:

- Providing technical support to NOAA, USCG, USAF, and other federal agencies in their operation and use of the international COSPAS-SARSAT satellite-based distress alerting system[1];
- Developing innovative hardware prototypes and enhancements to satellite-based SAR support systems;
- Actively supporting the SAR community at large, including NASA astronaut crew survival efforts;
- Technical support of the NOAA SARSAT program office, such as leading operational anomaly investigations, on-orbit testing of newly launched SARSAT satellites, chairing national and international meetings, providing technical guidance on frequency allocation and interference mitigation, and providing distress beacon approval review.

International COSPAS-SARSAT Program

COSPAS-SARSAT is an international space-based distress alerting system designed to provide distress alert and location information from distress beacons operating on 406 MHz, to SAR authorities worldwide.

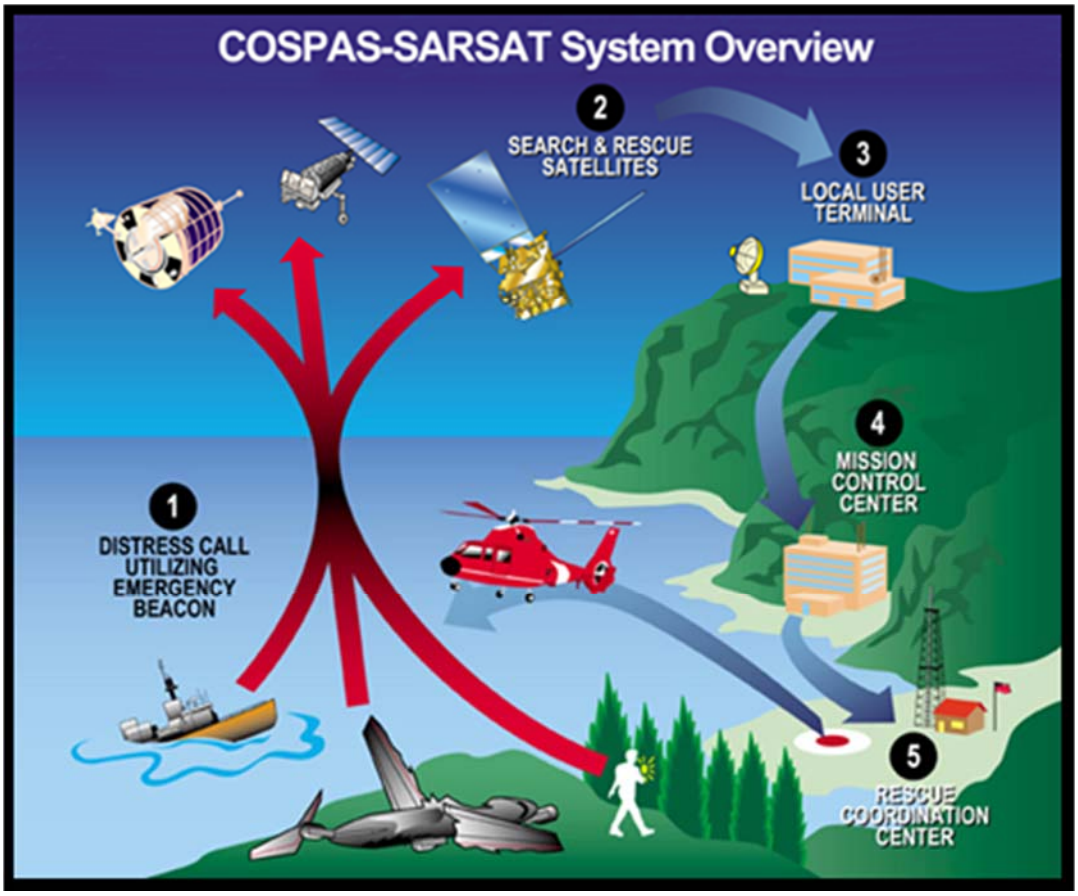
1 The SAR Mission Office maintains the SAR Laboratory (SARLab), which assists in much of this technical support.

The position of the distress and other related information is forwarded by the responsible COSPAS-SARSAT Mission Control Center (MCC) to the appropriate national SAR authorities. The purpose of the COSPAS-SARSAT system is to support SAR organizations with timely, accurate, and reliable distress alert information, whether at sea, in the air, or on land, globally.

System Concept

The basic concept of the system involves the use of distress beacons (Emergency Position Indicating Radio Beacon – EPIRB, Emergency Locating Transmitter – ELT; and Personal Locator Beacon – PLB), satellites, and ground equipment to relay distress location and identification information (referred to as distress alerts) to SAR authorities.[2]

SAR instruments are flown on low-Earth polar orbiting (LEO) and geostationary earth orbiting (GEO) satellites provided by the U.S., Russian Federation,



2 The COSPAS-SARSAT system also supports an International Maritime Organization (IMO) anti-Piracy effort with a class of beacons called Ship Security Alerting System (SSAS). These beacons are processed in the same way as EPIRBs, ELTs and PLBs, but are distributed to different authorities.

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India and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT). Canada and France provide the SAR instruments (the SAR Repeater and the SAR Processor) for the U.S. LEO satellites.

These instruments are capable of detecting signals on the Earth's surface transmitted from emergency beacons. The distress beacon, operating on the 406 MHz frequency, transmits a digital code that contains information about the type of beacon and possibly the location of the beacon (derived from GPS or other navigational systems).

EPIRB

ELT

PL

SAR Distress Beacons

Each distress beacon in the world has a unique identifier that allows additional information ("registration data") to be linked to the beacon and which assists SAR authorities in conducting the SAR operation. After receipt of distress beacon signals by the satellite, it relays the signals to Earth stations referred to as Local User Terminals (LUTs).

The LUT, after computing the location of the distress beacon using the Doppler Effect, transmits an alert message to its respective MCC via a data communication network. The MCC performs matching and merging of alert messages with other received messages, geographically sorts the data, and transmits a distress message to an appropriate SAR authority such as a national Rescue Coordination Center (RCC), foreign SAR Point of Contact (SPOC) or to another MCC.

Next Generation COSPAS-SARSAT System – MEOSAR

The NASA SAR Mission Office is working with national and international partners to complete the development of the next generation MEOSAR system. With the goal of initial operational capability in 2016, MEOSAR will provide near instantaneous detection and location of distress beacons installed on aircraft, maritime vessels, or carried by individuals, thereby enhancing the international community's ability to rescue people in distress.

MEOSAR Proof of Concept – NASA Distress Alerting Satellite System (DASS)

A 1997 Canadian government study[3] of possible satellite system alternatives, including commercial sources, determined that the ideal system would use Mid-Earth Orbiting (MEO) satellites. A MEO system would provide superior global detection and location data with fewer ground stations than the existing COSPAS-SARSAT system. The U.S. GPS constellation was identified as an ideal MEO platform.

NASA, in cooperation with the U.S. Air Force Space Command and the Department of Energy's (DOE) Sandia National Laboratories developed a new space-based SAR system called the Distress Alerting Satellite System (DASS). In February 2003, a MOA between NASA, NOAA, Air Force, Coast Guard, and DOE was concluded that:

- Addressed the development and demonstration of DASS, including a Proof-of-Concept (POC) space segment;
- Prototyped ground equipment to perform post-launch checkout, testing, and performance of a demonstration and evaluation program; and
- Committed to planning the implementation of an operational DASS.

The POC included NASA's development of a space segment using existing GPS satellites and a prototype ground station to perform post-launch checkout, performance testing, and implementation planning of an operational DASS system.

[3] CAL Corporation, *FOSS Report – Final Study* (Ottawa: CAL Corporation, 1997).

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The DASS prototype ground station was funded by NASA and installed at GSFC to demonstrate the effectiveness of the DASS concept, support additional performance analysis and improvement, and assist in the definition of future DASS. The ground station consists of four antennas, four receivers, workstations, and servers necessary to process the received data, command and control the operation of the ground station, and display and analyze the results. From 2006 to 2008, NASA developed the technology for the DASS POC system and confirmed its expected benefits.

NASA's initial DASS POC was considered a great success. It demonstrated that an MEO-based distress alerting satellite system could significantly improve the international community's ability to detect distress alerts. The DASS POC space segment will be replaced in the future by an operational space segment being designed specifically for MEOSAR and planned for launch on GPS Block III satellites equipped with a Canadian auxiliary SAR payload.

Search and Rescue Laboratory (SARLab)

The SARLab, located in Building 25 at GSFC, is a multi-function laboratory that contains all capabilities necessary to support the SAR mission research and development efforts. This facility allows the SAR Mission Office to monitor SAR Satellites, and support commissioning tests for SAR MCCs and LUTs, which make up the ground infrastructure of the SARSAT system. It is used for executing special tests and on-orbit verification of newly launched POES, GOES, and MEOSAR satellites, and serves as a research facility and a test bed to investigate possible improvements to the SARSAT system, including new technologies such as MEOSAR and second generation distress beacons.

The SARLab includes operational ground stations (both LEOLUT and GEOLUT), the world's first MEOSAR prototype ground station (MEOLUT), multiple distress beacon simulators with a variety of transmit antenna types, and other electronic test equipment.

Current SAR R&D Efforts

Second Generation Distress Beacons

The MEOSAR space segment allows for the beacon signal to be modified thereby enhancing system performance. NASA has led the development and testing of a second-generation distress beacon specification that is designed to meet the MEOSAR system's operational requirements.

The design goals are to:

- Improve system performance to meet or exceed ICSP requirements, including detection probability, location accuracy and system capacity;
- Modernize distress beacon signal for the MEOSAR system;
- Relax distress beacon requirements to reduce cost and complexity, and

SARLab at GSFC, Building 25

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- Collaborate with manufacturers to obtain the most competitive end product

NASA has developed a proof of concept system, including a programmable distress beacon and a real-time receiver capable of implementing the second-generation distress beacon waveform. NASA will utilize the proof of concept system to fully demonstrate and integrate the second-generation distress beacon signal in to the MEOSAR system.

SAR On a Chip

The development and miniaturization of the COSPAS-SARSAT beacon (a.k.a. SAR on a chip) will represent a leap forward in SAR beacon capabilities and applications. By combining the efforts of NASA's SAR Office, multiple GSFC engineering divisions, and Johnson Space Center's (JSC) Crew Survival Engineering team, NASA is able to streamline the fielding of a low-mass, low-volume, enhanced-capability personnel recovery system for use in manned spaceflight applications. This also stimulates the advancement of miniaturization technology for numerous applications, while enhancing both engineering experience and synergy among the NASA engineering disciplines.

This effort is a multi-year process to miniaturize a SAR beacon that maximizes the use of the SAR payload onboard GPS. This beacon will feature an order of magnitude location accuracy improvement, and will be able to locate persons in low-Earth orbit altitudes or high-velocity states, with increased detection probability.

Initially, the SAR team will develop specifications and a practical design concept for a beacon suitable for integration in the Modified Advanced Crew Escape Suit (MACES) through fabricating a mechanical prototype of the packaging for SAR on a chip. The SAR Mission Office, together with the JSC Crew Survival Engineering team will define requirements and resource constraints (e.g., mass, power, volume) for incorporation of the beacon into the MACES.

Goddard's engineering branches will evaluate design options and identify a practical, reliable, and cost effective approach to implement SAR on-a-chip in an RF ASIC. They will also develop specifications for the fabrication, assembly, and packaging of the RF ASIC. SAR on a chip will take advantage of ongoing GSFC development in miniature chip packaging. Finally, the engineering branches will provide electronics design and environmental test specifications of the board, producing a mechanical prototype of the beacon package.

Currently, there is no solution for crewmember emergency distress location that meets the size, mass, and environmental constraints for the astronaut suit. Historically, NASA's astronaut locating beacon systems have been large handheld systems with high impacts to the mass of crew survival systems. SAR on a chip will allow for an emergency rescue beacon to be installed on the MACES, rather than stowed during launch and landing, which gives rescue forces the individual locations of astronauts in the event of separation. With future effort, the receiver algorithms on-board SAR flight units will be upgraded to allow position determination both in-flight and during reentry.

ELTSAR: ELT Crash Survivability and Reliability

There is a long history of SAR ELTs failing in general aviation incidents. These failures have been studied to some degree by various agencies around the world, but until now, a comprehensive study has not been done. The NASA SAR Mission Office is partnering with the FAA/NTSB, Radio Technical Commission on Aviation (RTCA), and NASA Langley Research Center (LaRC) as part of a working group to improve crash survivability and functional reliability of ELTs.

The majority of aviation crashes occur in general aviation, representing the largest amount of data. NASA's LaRC has a strong history of research in aviation accidents, including studies and testing of crash scenarios. NASA SAR leads this effort, including coordination with COSPAS-SARSAT, as these failures drive a global impact and need for improved reliability. This has been widely noted with recent events such as the loss of Malaysian Air 370.

The primary goal of this study is to deliver recommendations to the FAA, beacon manufacturers, and airframe manufacturers on ways to increase ELT survivability. As part of this effort, the SAR team is researching historical ELT failures in general aviation (light aircraft) accidents, and gathering data to determine reasons for low survivability. The SAR team will study the data, conduct trades, and

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develop new procedures and processes for beacon design and installation as findings dictate. As part of this study, the SAR team will define recommendations for ELT design and installation requirements, testing these procedures on a system level (beacon, antenna and cabling, mountings, etc.). NASA will analyze results from test crashes performed at the LaRC Landing and Impact Research Facility. The SAR team will then develop recommendations based on comprehensive test results. It is their hope that they will be able to improve ELT survivability on a global level through coordination and information transfer via COSPAS-SARSAT channels.

The NASA SAR Mission Office at GSFC is providing the overall coordination and management of the ELT working group effort, reporting to HQ. They will be coordinating with other countries and various agencies to gather global data and keep an eye on the "big picture". Interfacing with COSPAS-SARSAT on ELT matters, these findings will eventually be presented to an international forum as well as the FAA.

Concluding remarks…

The NASA SAR Mission Office is committed to excellence in the research and development of SAR systems, with the ultimate goal of saving lives. If you would like more information on the NASA SAR Mission, COSPAS-SARSAT Program, and national SAR efforts, please refer to the following resources.

NASA SAR Mission Office website:
http://searchandrescue.gsfc.nasa.gov/

NASA Langley Research Center Landing and Impact Research Facility (LandIR)
http://gftd.larc.nasa.gov/facilities/landir.html

International COSPAS-SARSAT Program
https://www.cospas-sarsat.org/en/

National Search and Rescue Committee (NSARC)
http://www.uscg.mil/hq/cg5/cg534/NSARC.asp

U.S. Coast Guard SAR Office
http://www.uscg.mil/hq/cg5/cg534/

U.S. SAR Operations – NOAA
http://www.sarsat.noaa.gov/

Anthony W. Foster, Code 450.3
NASA Search & Rescue Mission Office /

Quotes to Think About

"A gaffe is when a politician tells the truth."

Warren Buffett

"Well done is better than well said."

Benjamin Franklin

"Don't judge each day by the harvest you reap but by the seeds you plant."

Robert Louis Stevenson

"The strongest man in the world
is the man who stands alone."

Henrik Ibsen

"I think that I shall never see

A billboard lovely as a tree

Indeed, unless the billboards fall

I'll never see a tree at all."

Ogden Nash

"When angry, count a hundred;

When very angry, swear."

Mark Twain

"When men drink,
then they are rich and successful
and win lawsuits and are happy
and help their friends.

Quickly, bring me a beaker of wine."

Aristophanes

The Journey from Suomi NPP to JPSS-1 and Beyond

NASA's Joint Polar Satellite System (JPSS) program has a new Deputy Program Manager, Jackie Townsend, coming on board as the program solidifies plans for the next 25 years of polar observations for the National Oceanic and Atmospheric Administration (NOAA). Together NASA and NOAA are leveraging more than 40 years of experience developing satellites to shape the future of the polar orbiting weather and climate satellites in the JPSS program.

With significant technological advances, JPSS will ensure continuity of observational data at the quality needed to sustain and improve weather forecasts and environmental monitoring and will help advance weather, climate, environmental and oceanographic science.

Suomi National Polar-orbiting Partnership (Suomi NPP) launched on October 28, 2011, was designed to demonstrate a new generation of weather and climate instruments, and is serving as a bridge to the JPSS series of satellites. NOAA and NASA are on track for the launch of JPSS-1 in early 2017. The JPSS-1 instruments are currently completing environmental testing and observatory integration and test will begin later this year.

NASA is responsible for developing and building the JPSS instruments and spacecraft and the ground system that controls the satellites and handles the observational data produced. NOAA is responsible for managing the JPSS program, operating the satellites, and delivering science data products to users around the globe including NOAA's National Weather Service and the National Hurricane Center.

Jackie Townsend joined the NASA JPSS team two years ago as JPSS chief architect to help ensure the continuity of weather data by beginning planning for future missions (JPSS-2 and beyond). Townsend came to NASA's Goddard Space Flight Center more than 20 years ago as a co-op in the Materials Engineering Branch while she completed her Bachelor of Science degree in physics.

Townsend developed expertise in space environmental effects, and came to work on the Hubble Space Telescope (HST) project to better understand degradation of blanket materials. She then served as the contamination engineering manager for the HST Servicing Mission 3B and managed the Wide Field Camera 3 instrument that was installed in the telescope during Servicing Mission 4 in 2009. From 2009 through 2012, Townsend led strategic planning for NASA's Physics of the Cosmos and Cosmic Origins Programs in Code 440.

As the JPSS Chief Architect, Townsend used this breadth of experience to explore options for meeting JPSS's polar observation requirements through the mid-2030s. Townsend said, "The main challenge of an architecture study is finding the right balance between the broad objectives and the details. The architect must approach the problem in a way that can be handled with the time and resources available and still attend to the details that will influence the outcome of the study." For JPSS, to understand the cost/benefit relationship of one large mission versus disaggregation into many small missions, she led the development of a tool to estimate the relative cost and merits of more than 5,000 mission scenarios and pared the list down to six promising possibilities. The team then defined the interdependencies between annual funding requirements, total lifecycle cost and launch readiness schedule for three different approaches. Over the next year, NOAA and JPSS will use these data to determine which approach to pursue for the missions beyond JPSS-2.

Now as the Deputy Program Manager, Townsend will apply her skills to the full program content. With Suomi NPP operating on-orbit, JPSS-1 ready to start observatory integration and test, and JPSS-2 beginning procurements, the program has instruments and missions at every stage of development simultaneously. "JPSS is unusual in that we have an opportunity to apply lessons learned on our own program, reaching forward to improve future builds and sometimes reaching back to improve the performance and reliability of the on-orbit system," Townsend said.

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The JPSS series of satellites are a critical element in maintaining NOAA/NASA climate knowledge continuity for the afternoon polar orbit. JPSS will improve weather forecasting and knowledge of transient Earth events, and will provide time-critical weather information used for weather forecasting by NOAA and international partners.

Contributed by the JPSS Program Office

Former Center Director Noel Hinners Passes Away at 78

Dr. Noel Hinners, former Goddard Center Director from 1982 to 1987 and NASA Chief Scientist, died in Colorado this past September. In addition to a long career at NASA, Dr. Hinners also served as director of the National Air and Space Museum, and after leaving NASA was Vice President of Flight Systems for Lockheed-Martin before retiring in 2002.

Cultural Tidbits

Did you Know…….

why Veterans Day is always on November 11th? World War I officially ended on June 28, 1919 with the signing of the Treaty of Versailles. Fighting ceased between the Allied nations and Germany on November 11, 1918. November 11th as a result was commemorated as Armistice Day and became an official holiday in 1938. After World War II, in 1954 “Armistice” was replaced with “Veterans” to honor American veterans from all conflicts and service. Please remember to thank and honor our veterans for their service.

Do you have a cultural tidbit to share? Send it to the Code 400 Diversity Council c/o Matthew Ritsko at:
matthew.w.ritsko@nasa.gov
and we'll publish it in a future issue of The Critical Path.

Social News

* Mansoor Ahmed's (Code 440) filmmaking team, Storytellers, won the Audience Choice Award for the Best Short Film for their film, *The Ring*, at the DC South Asian Film Festival in September.

* Best wishes to Jackie Mattson (Code 408) and Jay McGaha (Code 224), who were married on October 17, 2014.

* Congratulations to Cynthia Simmons (Code 491), who successfully passed the final testing in the full examination for Black Belt for Chen Taiji (Tai Chi) on November 8. She has been studying Chen Taiji under Coach Christopher Pei for 15 years at the U.S. Wushu Academy (USWA) in Fairfax, Virginia.

* Best wishes to Helen Phillips and John Baniszewski, both retired DPMRs, who married August 30, 2014 in Ellicott City.

* Steve Metcalf (retired from Code 423), has been playing a lead role ("Panisse") in the MAD production of the musical "Fanny." The ESDIS Project turned out in force to enjoy Steve's performance on Saturday, November 1st.

* Bob Hesenperger (Code 490) and his wife Julie have become grandparents, and are glad to join the grandparents club! Their grandson, Robert, was born on November 12, weighing in at 8 lbs., 12 oz., and measured 20-¾ inches long. Parents Nichole and Chris Jordan are excited as well.

Bob Hesenperger and new grandson, Robert

Mansoor Ahmed and the 'Storytellers'

Newlyweds John Baniszewski and Helen Phillips

Steve Metcalf and members of the ESDIS team. Left to right: Diane Trakas, Beverly Metcalf, Steve Metcalf, Marty Citko, Dawn Lowe, Ed Sofinowski, Selene Annadale, and Jeanne Behnke.

Knowledge Management Corner

Guidelines for Documenting Project Lessons Learned

Part One – Methods for Generating and Documenting Lessons

Per NPR 7120.5, your Project Implementation Plan includes a section on lessons learned (a Lessons Learned Plan) stating that 1) the project will pay attention to lessons learned from other projects and 2) the project will document its own project lessons so that other projects can benefit from them.

There are many ways to collect and document lessons learned. No single approach is always the most appropriate. The Pause and Learn (PaL), as a facilitated group discussion, is adaptable to a wide range of needs and situations. The following factors should be taken into account in determining the best approach.

1. Support from the Flight Projects Directorate (FPD)

Seek the assistance of the FPD Knowledge Management point of contact (no cost to projects) to:

1) develop a Lessons Learned Plan tailored to the needs of the project;

2) organize and facilitate PaL sessions to gather lessons from the project team;

3) document lessons learned for inclusion in the FPD's Knowledge Exchange and Goddard Knowledge Exchange (as appropriate).

2. Group vs. Individual Lessons

Option 1: Solicit lessons learned from individual team members and aggregate the lessons into one collection.

Advantages: Everyone can contribute if they wish to.

Disadvantages: Duplication of lessons, narrow/individual perspective; only individual learning happens, if at all.

(KM continued on page 15)

(KM continued from page 14)

Option 2: Organize a facilitated group discussion of lessons, such as a PaL session.

Advantages: The group conversation around lessons is critical for every participant to come with a new understanding of the project lessons, not just their individual lessons.

Disadvantages: Group discussions can be dominated by a few individuals; some individual voices may not be sufficiently heard.

Option 3: Solicit individual lessons learned and then organize a facilitated group discussion of lessons, such as a PaL session.

This option combines the benefits of individual reflection and group consolidation of learning.

While it may be useful to solicit individual lessons learned as an initial step in identifying key topics to focus on (scoping the lessons learned activity), a group discussion of lessons is critical. A presentation-style session where individual lessons are discussed is not recommended, as it would take a lot of time to discuss each individual lesson and would not generate the group discussion that is needed.

3. Scope of the Lessons Learned Activity

The scope of the Lessons Learned activity should be aligned with the specific intent of the activity. The scope of a lessons learned activity after launch may be quite different from the scope of a lessons learned activity entering the Integration and Testing (I&T) phase. There are times when limiting the scope of a lessons learned activity is both appropriate and a good use of limited time. For example, a project team may schedule a PaL focused on a topic of great importance in the coming project phase, such as entering a heavy I&T phase.

In the context of a PaL session, the time allocated for the session needs to be aligned with the scope selected. Most PaL sessions are scheduled for 90 minutes. When appropriate, multiple sessions can be scheduled in succession, perhaps even in the context of an off-site meeting, or across several days or weeks.

How are you going to identify topics to focus on?

Option 1: Bottoms up – let team members submit lessons learned topics and consolidate topics into a single list;

Option 2: Project Management identifies key topics and solicits lessons learned based on the key topics identified.

4. Level of Participation and Inclusiveness

Once you have identified the scope of the lessons learned activity, it is much easier to determine who needs to be involved. A typical PaL session brings together 10 to 20 project team members, including the project management team and relevant representatives from science and engineering, as well as partners and contractors (as appropriate).

5. Timing

Lessons Learned activities should be conducted at regular intervals throughout the project life cycle. Projects should conduct a PaL session after each Key Decision Point (KDP). However, there are many opportunities beyond KDPs to conduct lessons learned activities that could be of great benefit to the project. Until after launch, it helps for the project to focus its lessons learned activities on lessons that have an immediate impact on the project or other ongoing projects rather than lessons to benefit future projects. When the time comes after launch to identify lessons learned useful to other projects, the intermediate lessons learned collected throughout the project life cycle will be valuable reminders.

Part 2 of this article, focused on "Writing High Quality Lessons Learned" can be found in the Knowledge Management Corner, in the FPD Knowledge Exchange.

Related Resources:

FPD Knowledge Exchange (Home Page)

Pause and Learn Implementation Guide

Guide to Lessons Learned for Programs, Flight Projects and Instruments

For additional information contact Barbara Fillip (301) 286-4666.

Barbara Fillip, Code 400
Knowledge Management Project Manager

Project Management Development Emprise

Front row (l to r): Howard Ottenstein (PMDE Facilitator); George Morrow (Director of Code 400/ Chairman, PMDE Advisory Board); Valerie Mackritis (last PMDE Graduate); Beverly Thomas (Deputy Administrative Supervisor to Valerie); Linda Greenslade (Member PMDE Advisory Board).
Back row (l to r): Richard Ryan (Member PMDE Advisory Board); Christine Hinkle (Administrative Supervisor to Valerie); Tracy Parlate (Mentor to Valerie); Steve Shinn (Deputy Director of Code 400 for Resources/Deputy Chairman, PMDE Advisory Board).

A Project Management Development Emprise (PMDE) program graduate ceremony was held in the Code 400 suite on October 1 at 10:30 a.m. Director of Code 400, George Morrow, presented Valerie Mackritis with her graduation plaque. Valerie was the last of several dozen graduates of this historic training program for technical and resource personnel begun in 1990. Graduates include many project managers and deputy project manager (resources) at the Center as well as senior managers at Headquarters, other NASA Centers, and in industry. So successful was this program that NASA Headquarters modeled its own PMDP program on Goddard's PMDE.

Since last year a new and updated training program, an enhanced PMDE, was created. Its first class is now well under way.

George Morrow, Director of Code 400 ; Chairman, PMDE Advisory Board and graduate Valerie Mackritis

Code 400 Peer Awards for 2014

Mission Impossible

Julie Janus
In recognition of your exceptional support in leading, guiding and advising project personnel through the NICER procurement process.

Tom Kenney
In recognition of your ability to juggle the integration, testing and delivery of the GOES-R System Module, while supporting the transition and closure of the Lockheed Newtown facility.

Larry Long
In recognition of your unparalleled dedication in making the Remote Robotic Oxidizer Transfer Test a success.

Michael Pasciuto
In recognition of your fortitude in creating and leading the InVEST Program, a missing link in technology validation, to further reduce mission risk at GSFC and NASA.

Honoring Diversity

Donna Swann
For making a positive influence to lead, promote, and foster an inclusive workplace for the Flight Projects Directorate and the employee.

Mentor “Under Your Wing”

Jane Liu
In recognition of your exceptional work as a role model and mentor, both for the TDRS Project and GSFC.

Rachel Rivera
In recognition of your willingness to take others under your wing as the Lead Contamination Control Engineer on DSCOVR.

Boundless Energy

Carolyn Keene
For demonstrating agility, balance and dedication to the TDRS project during the TDRS-L launch campaign and beyond.

Clelia Walker
In recognition of your extraordinary leadership as CO for the GOES-R Spacecraft and ABI development contracts, as well as the support she selflessly provides to others on the GOES-R team.

(Peer Awards continued on page 18)

(Peer Awards continued from page 17)

Cristy Wilson
In recognition of your extraordinary commitment to excellence and dedication to the ESC Projects Division.

Silo Slammer

Robert White
For establishing a vision that crossed organizational boundaries to help deliver the best business products for the new Instrument Projects Division and the Flight Projects Directorate.

Unsung Hero

James Barcus
In recognition of your unbelievable level of commitment to your peers, the Flight Projects Directorate, and Goddard Space Flight Center.

Kevin Mangum
In recognition of your leadership, knowledge and experience in information security governance, risk management, and compliance in support of mission operations.

Jean Plants
For exceptional dedication and teamwork in the financial arena, leading to success of the Mars Atmosphere and Volatile EvolutioN (MAVEN) mission from design through launch.

Elizabeth Prince
For being a vital part of the SIDAR Project team and demonstrating your willingness to adapt to new challenges on a daily basis.

Scott Reynolds
In recognition of your outstanding dedication and team work on cost/schedule earned value initiatives on ICESat-2, GSFC and NASA.

Shelley Rice-Pinkard
In recognition of your dedication and expertise as the Configuration Management Officer (CMO) for the Earth Science Data and Information System (ESDIS) Project.

Rookie of the Year

Jahi Wartts
In recognition of your commitment to seek opportunities and to advance management of ATLAS to effectively communicate financial and schedule needs.

Janet Yau
For your impressive ability to get up to speed with the TDRS Project's financial responsibilities, demonstrating both agility and dedication.

(Peer Awards continued on page 19)

(Peer Awards continued from page 18)

Steady Helm

Gustave Comeyne
In recognition of your extraordinary leadership of the GOES-R Solar Ultra Violet Imager development team and success in team efficiency and effectiveness.

Kenny Finnegan
Going above and beyond as GPM prepared and conducted Launch Campaign activities (with a Smile and Great Attitude).

Krysti Gunter
For providing highly reliable technical assessments that cut across multiple SGSS teams, as well as an unwavering, results-oriented focus on SGSS mission success.

Martin Houghton
In recognition of your outstanding technical leadership and commitment to the MAVEN mission.

Arthur Jacques
In recognition of your Steady Helm leadership of FPI, the Ping proposal, and mission and instrument formulation for the Flight Projects Directorate.

Mary Lapelosa
For keeping the TDRS team focused and moving forward fostering an environment of mutual respect and good morale.

Randy Race
In recognition of your ability to foster a climate of mutual respect, creativity, teamwork, and calm within the GOES-R program and among its diverse stakeholder community.

Ronald Williams
In recognition of your extraordinary leadership of the GOES-R Advanced Baseline Imager development team and your remarkable commitment and focus to team work.

Wild Card

Jennifer Brennan
In recognition of your devoted support to EOSDIS outreach efforts on behalf of the Earth Science Data and Information System (ESDIS) Project.

Miles Glasgow
In recognition of your impressive ability to reflect the best values of the Flight Projects Directorate and the TDRS Project.

Candace Masters
In recognition of your outstanding Systems Engineering Support during Astro-H Flight Hardware Integration and Cryogenic Performance Testing at GSFC and in Japan.

Comings & Goings

July 1, 2014 through September 30, 2014

Comings:

* Brian C. Thomas (from 201) to 423/ESDIS Project, Senior Resources Analyst
* David A. Content (from 592) to 448/WFIRST, Payload Systems Manager
* Yi-Pheng Ngan (from 566) to 454/TDRS Deputy Telecommunications Systems Manager
* Kelly K. Hyde (from 580) detailed to 444/SSMO Project, Project Support Assistant

Goings:

* Paul A. Deminco retires from 401/ACFO, Study Manager
* Fred G. Cunningham retired from 417/GOES-R, Instrument Systems Manager
* Thomas Johnson (from 490.3) to 800/SmallSat Manager
* Deborah A. Clark retires from 401/ACFO, Program Specialist
* Carla A. Ridgeway retires from 405/Resource Analysis Office, Technical Information Specialist
* David M. Scheve resigns from 400/Flight Projects Directorate, Deputy Director
* Kwasi D. Horton (from 426) to 603/Resources Analyst
* Hampapuram K. Rampriyan retires from 423/ESDIS Project, Technical Resources Management

Reassignments/Realignments/Details within Code 400:

* Paul W. Richards (from 417) to 451/LCRD Project, Deputy Project Manager
* Eric M. Krupacs (from 426) to 420/Mission Manager for the International Space Station
* William J. Potter (from 461) to 493/LCRD Instrument Project, Deputy Instrument Project Manager
* Vickie E. Moran (from 461) to 460/TESS Project, Deputy Project Manager
* Tynika N. Rawlings (from 443) to 458/Space Network Ground Segment Sustainment, Financial Manager
* Cristy Wilson (from 455) to 453/Near Earth Network (NEN) Project, Financial Manager
* Monique S. Collins (from 403) detail to 491/ATLAS Instrument Project

(Comings and Goings continued on page 21)

(Comings and Goings continued from page 20)

* Julie K. Hostetler (from 423) detail to 470/JPSS Program Office
* Mark Jarosz to GOES-R Flight Project, Observatory Manager
* Robert J. Menrad to 450/Associate Director of Exploration & Space Communications Projects Division
* Reginald D. Eason (from 460) detail to 420/ESMP Pre-Formulation Mission Manager
* David F. Mitchell (from 460) to 400/Flight Projects Directorate, Deputy Director
* Melissa F. Rice (from 450) to 455/Exploration Systems Project, Sr. Resources Analyst

Reorganizations within Code 400:

* *Rename Polar Free Flyer Project to the Solar Irradiance Data and Rescue (SIDAR) Project, Code 424* (Pending)

Lisa Hoffmann, Code 400
Administrative Officer

(Waylus continued from page 3)

physics Observer (SoHO), SRB Chair for the Space Network Ground Segment Sustainment (SGSS) Upgrade Project, and as the Deputy Project Manager for the SGSS Project.

Most of his years at Goddard were spent on the Hubble Space Telescope project, including working on four of the five Servicing Missions. While on Hubble, Keith served as an operational systems engineer, the Deputy Operations Manager, and finally as the Servicing Operations Manager for the final Servicing Mission in 2009.

Family

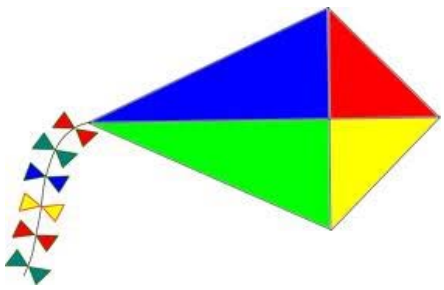
Keith and his wife Christine live in Arlington, Virginia. They have three daughters, Josie (12), Evelyn (9), and Rebecca (9), and a highly energetic wheaten terrier named Riley. Most of their spare time is spent shuttling their daughters to their various activities including gymnastics, synchronized skating, piano and guitar lessons.

(Mackritis continued from page 3)

budgeting/executing other segments of the organization's budget such as Code 600 tax accounts. She is currently providing financial support to the NICER mission, assisting in the execution and analyses of Program Office budgets in accordance with established plans and schedule. Valerie is a recent graduate of the Project Management Development Emprise (PMDE) program.

Life Outside of Goddard

A military brat and a retired veteran of the United States Air Force, Valerie has lived in Germany, Japan, England and Guam, as well as numerous cities in the USA. Her hobbies include writing, kite flying and aerobics.



Howard Ottenstein – Opening a New Chapter in Life

After a career spanning more than 50 years at the Goddard Space Flight Center, the one and only editor of The Critical Path (TCP), Howard Ottenstein, is hanging up his red pen. Howard and his wife Marcia are moving from their home of 53 years in Catonsville, Baltimore County to Long Island to be near their two youngest grandchildren, aged 2 and 4. They will continue to spend their winters in Florida.

A native of Brooklyn, Howard graduated from Brooklyn College, served in the Marines from 1951 to 1953, and later received a master's degree in history from New York University. Howard worked with several aviation companies in the New York area until 1964, when he was offered the chance to move south to begin work at Goddard in the Resources field. He worked with Code 600 for several years and then moved to the Flight Projects Directorate (FPD), where he worked as a Program Analyst from 1989 until 2005.

Howard achieved a level of fame in 1979 with the publication of a book he wrote called "Beat the Bureaucracy." The fact-filled book provided information on "who does what and why in the Federal government" and was featured in 'The Pittsburgh Press' that year. For several years Howard also wrote a Federal column for the 'Baltimore Sun,' similar to the old Mike Causey column in the 'Washington Post.'

In 1991, Howard approached Vern Weyers, then FPD Director, about the idea of creating a Code 400 newsletter that would allow FPD employees to share work-related achievements, personal highlights, and items of interest. He got some good ideas from the popular 'Reader's Digest' magazine, including the "Quotes to Think About" and "Personality Tintypes." Operating on a shoestring budget, Howard pulled together the magazine three to four times a year, working with one editorial assistant and one layout person. After 23 years, it's still going strong!

After retiring from the government, Howard continued to work under a support services contract as TCP editor and as a facilitator for the Project Management Development Emprise which began in 1990 and just completed its final graduating class (see story on page 16). He found that most rewarding and loved the interaction that role brought him with up-and-coming management trainees.

Always quick-witted and ready with a snappy response, Howard played the role of curmudgeonly editor with great gusto. He was a fixture in the halls of Building 8 and was known by so many people around Center. He will certainly be missed by his TCP colleagues but we are hopeful that he will still be on the lookout for interesting articles to share with his former co-workers, and that he, like so many other retirees, might come to depend upon TCP to catch up on the latest news about what's going on around Goddard, and to monitor the comings and goings of the Goddard family he has left behind.

Of course, we have to let Howard have the last word, in his usual inimitable style!

"The Time Has Come"

"The King James Bible states: "The days of our years are threescore years and ten; and if by reason of strength they be fourscore years, yet is their strength labor and sorrow; for it is soon cut off, and we fly away." Having already been blessed with fourscore and four years, I am hopeful that rather than fly away, I will follow in the steps of General McArthur, who once said: "Old soldiers (editors) never die, they just fade away."

Howard – you won't fade from our memories, that's for sure!

Wishing you Happy Holidays!!

The staff of The Critical Path extend best wishes for a very happy Holiday Season!!

We're on the WEB

http://fpd.gsfc.nasa.gov/news.html

or via the Code 400 Homepage

http://fpd.gsfc.nasa.gov

Thank you Goddard for 50 years of working with interesting people and interesting work. Of course, If you enjoy what you do, you've never really worked a day in your life. My wife and I will be moving to Long Island to be near our youngest (ages 2 and 4) grandchildren. I wish you all good fortune in all your personal and Center endeavors. Until it is decided who will be the next Editor of The Critical Path, please forward all material for the spring (April) issue to Paula Wood:

Paula.L.Wood@nasa.gov,

Howard Ottenstein, Editor
Code 403

FUTURE LAUNCHES CY 2015	
Soil Moisture Active & Passive (SMAP)	January 2015
Deep Space Climate Observatory (DSCOVR)	January 2015
Magnetospheric Multiscale Mission (MMS)	March 2015
Space Environment Testbeds (SET-1) (Living With a Star (LWS) Program)	August 2015
Astro-H	November 2015

The Critical Path

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Editorial Assistant

If you have a story idea, news item, or letter for The Critical Path, please let us know about it.
Send your note to Paula Wood via email: Paula.L.Wood@nasa.gov,
Mail: Code 460, or Phone: 6-9125.
Don't forget to include your name and telephone number.
Deadline for the next issue is April 20, 2015.